



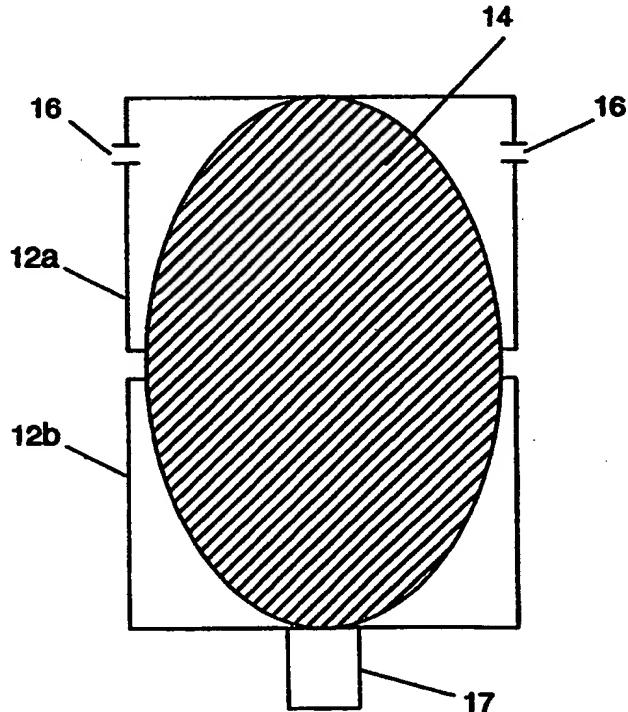
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> :		A1	(11) International Publication Number: <b>WO 99/10180</b>
B41J 2/195			(43) International Publication Date: 4 March 1999 (04.03.99)
(21) International Application Number: PCT/IL98/00399		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 23 August 1998 (23.08.98)			
(30) Priority Data: 121640 27 August 1997 (27.08.97) IL			
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(54) Title: AN INK CARTRIDGE

## (57) Abstract

An ink cartridge (10) is provided which includes a rigid housing (12) and a flexible ink storage bag (14) inserted within the housing (12). The storage bag (14), which is connectable to the ink supply line (21) of a printer by means of a hollow needle (22), is impenetrable by the needle (22) or similar when the storage bag (14) is depleted of ink.



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## AN INK CARTRIDGE

### FIELD OF THE INVENTION

The present relates to replaceable ink cartridges used with ink-jet printers in general and to the preventing the use of non-genuine ink cartridges in particular.

### BACKGROUND OF THE INVENTION

Ink-jet printers use cartridges filled with ink for the production of the printed pages. Except for printing paper these cartridges are the major consumable item used with the printers and need replacing on a regular basis. It is in the interest of the printer manufacturers to ensure that only their own original replacement cartridges are used. However, there is a large secondary market for the ink itself either sold on its own for the consumer to fill the used up cartridge and for non-original replacement cartridges refilled with ink by those ink-manufacturers. These non-original ink sources can cause malfunction of the printer or even permanent damage.

Manufactures of thermal bubble print heads utilize expendable cartridges which include the thermal head as part of the cartridge. The thermal head as well as the cartridge is thus disposable, and can not be reused.

Alternatively, other printers use heads which are a permanent part of the printer. The type of cartridge used with permanent head printers comprises an ink bag for storing the recording ink. US Patent No. 5,157,421 to Kithara and EP

Patent No. EP 0 661 160 to Nishioka, for example, describe replaceable ink jet cartridges for use with ink jet printers.

A disadvantage of ink bags (from the manufacturer's point of view) is that they are relatively easy to refill and imitate. The manufacturers of original equipment are, thus interested in preventing other sources from refilling the cartridges and copying or faking their original cartridges.

## SUMMARY OF THE INVENTION

An object of the present invention is to provide an ink cartridge which cannot be tampered with and which cannot be refilled by outside sources, thereby overcoming the limitations and disadvantages of existing cartridges.

5 A further object of the present invention is to provide an ink cartridge whose authenticity can be checked so as to deter the production of non-authorized copies.

There is thus provided, in accordance with a preferred embodiment of the present invention, an ink cartridge which includes a rigid housing and a 10 flexible ink storage bag inserted within the housing. The storage bag is connectable to the ink supply line of a printer by means of a hollow needle. The storage bag is impenetrable by the needle or similar when the storage bag is depleted of ink.

Furthermore, in accordance with a preferred embodiment of the present 15 invention, the housing includes upper and lower chambers connectable together. In addition, the housing further includes an outlet port for connecting the housing to the printer.

Furthermore, in accordance with a preferred embodiment of the present invention, the hollow needle includes an angled sealed point formed in one end 20 thereof.

Furthermore, in accordance with a further preferred embodiment of the present invention, the ink cartridge includes a metal element placed on top of the

ink storage bag so that the metal element descending as the ink storage bag is emptied. In addition the metal element includes an annulus formed therein and is also composed of a ferrous material.

Furthermore, in accordance with a further preferred embodiment of the 5 present invention, the printer includes a magnetic sensor proximate to the bottom of the lower chamber for sensing the presence of the ferrous metal element thereby to indicate the depletion of the storage bag.

In addition, in accordance with a further preferred embodiment of the present invention, the ink cartridge further includes an indicator representing a 10 logo attached to the exterior face of the housing. The indicator is composed of conductive material responsive to electro-magnetic fields and the printer includes a detector for detecting the form of the indicator.

Preferably, the detectable metal logo is placed on a mechanically formed raised or recessed shape of the logo, and a negative shape is included in 15 the housing of the printer. Thus, it is necessary to insert the raised mechanical form into the recessed mechanical form of the logo, in order to fit the cartridge to the printer.

Furthermore, the ink cartridge includes a processing unit which may be coupled to the central processing unit of the printer.

20 Additionally, there is also provided, in accordance with a preferred embodiment of the present invention, a method for verifying the authenticity of an ink cartridge. The ink cartridge has a processing unit coupled thereto and the method includes the steps of:

- a) installing and connecting the ink cartridge to a printer having a central processing and control unit (CPU) connected thereto;
- b) the CPU sending a randomly generated number ("code") to the installed ink cartridge;
- 5 c) the CPU performing a first encryption algorithm on the code;
- d) the cartridge processing unit performing a second encryption algorithm on the code;
- e) comparing the resulting first and second encryption algorithms; and
- f) indicating an error if the resulting first and second encryption algorithms are not identical.

10

**BRIEF DESCRIPTION OF THE DRAWINGS**

The present invention will be understood and appreciated more fully from the following detailed description taken in conjunction with the appended drawings in which:

5 Fig. 1 is an illustration of an ink cartridge, according to a preferred embodiment of the present invention;

Figs. 2A and 2B are cross sectional illustrations of the ink bag within the ink cartridge of Fig. 1;

10 Figs. 3A and 3B are detailed illustrations of the outlet port of the ink cartridge of Fig. 1;

Fig. 4 is a cross sectional illustration of an almost emptied ink cartridge of Fig. 1;

Fig. 5 is a cross sectional illustration of an ink cartridge, according to a further preferred embodiment of the present invention;

15 Figs. 6A and 6B are enlarged cross sectional details of the ink cartridge of Fig. 5;

Fig. 7 is a cross sectional illustration of an almost emptied ink cartridge of Fig. 5;

20 Fig. 8 is a cross sectional illustration of an ink cartridge, according to a further preferred embodiment of the present invention; and

Fig. 9 is a flow chart illustration of the method for detecting a genuine ink cartridge.

## DETAILED DESCRIPTION OF THE PRESENT INVENTION

Reference is now made to Fig. 1 which is an illustration of an ink cartridge, generally designated 10, according to a preferred embodiment of the present invention. Cartridge 10 comprises a rigid housing 12 having upper and lower chambers, referenced 12a and 12b, respectively, into which an ink-filled bag 14 is placed. As best seen in Figs. 2A and 2B, to which reference is now also made, the ink-filled bag 14 is placed in the lower chamber 12b of the cartridge 10 and the upper chamber 12a is placed over the bag 14 (Fig. 2A). The upper and lower chambers, 12a and 12b, respectively, of the cartridge 10 are glued together, 10 or closed in any other way, which renders housing 12 as one unit. The lower chamber 12b comprises a neck 17, integrally formed therewith, which acts as the outlet port 18 for the ink within the bag 14. Neck 17 facilitates the connection of cartridge 10 to the printing mechanism (not shown). The rigid housing 12 comprises a plurality of puncture holes 16, to keep the inner part at atmospheric 15 pressure.

The bag 14 is filled with ink, prior to being inserted into the cartridge 10, by any known method, such as inserting a syringe into the top of the bag 14, filling with ink and then sealing the hole made by the syringe. The full bag 14 has a generally oval shape (Fig. 2A) which is compressed into a generally spherical 20 shape (Fig. 2B) on being locked into the rigid housing 12.

The ink bag 14 is comprised of any suitable flexible material, such as latex rubber, plastics or aluminum foil.

Reference is now also made to Figs. 3A and 3B which schematically illustrate the outlet port 18. A rubber plug 20, or similar device, is suitably inserted and fixed within the outlet port 18 (neck 17 of cartridge 10) to act as a seal.

Outlet port 18 is connectable to the ink-supply line 21 of the jet printing mechanism (not shown). Ink-supply line 21 comprises a fixed hollow needle 22 having an angled sealed point 24 formed in one end thereof, which penetrates bag 14 through plug 20 to feed the ink to the printer once the cartridge 10 is inserted. An aperture 26, which is formed proximate to point 24, acts as entry point for the ink and prevents the formation of air bubbles. The penetration of needle 22 into the bag 14 is facilitated by the fact that the bag is full of ink and tightly enclosed in housing 12.

A stopper 28 is fixed around needle 22. The position of stopper 28 on needle 22 determines how deeply the needle 22 penetrates the bag 14.

In operation, as the ink is drawn off (by force of gravity), the bag 14 gradually collapses until it rests on top of the needle 22, as shown in Fig. 4, with a small quantity of ink still within the bag 14. Once the supply of ink has been exhausted, the cartridge 10 is pulled upwards away from needle 22 and discarded. Plug 20 prevents any remaining ink from leaking out of the bag 14.

Once the bag has been depleted of ink, it cannot be refilled since the depleted ink bag 14 is in a collapsed state, and any filling needle will not be able to penetrate the flexible bag.

Reference is now made to Fig. 5 which is a cross sectional illustration of an ink cartridge, generally designated 100, in accordance with a further embodiment of the present invention.

Elements of this embodiment of the invention which are similar to 5 elements which have been previously described with respect to the preferred embodiment hereinabove, are similarly designated and will not be further described.

Ink cartridge 100 comprises a rigid housing 12 into which an ink-filled bag 14 is placed. Housing 12 comprises a neck 17, integrally formed therewith, to 10 facilitate the connection of cartridge 100 to the printing mechanism (not shown).

Ink cartridge 100 further comprises a metal disc 102 which is placed on top of the full ink bag 14, prior to the housing 12 being closed.

Metal disc 102 is preferably composed of a ferrous material having magnetic properties. The presence of metal disc 102 increases the vertical 15 pressure on the ink bag 14 thereby improving the efficiency of the ink flow to the printer.

Furthermore, metal disc 102 can be used in conjunction with a magnetic sensor, generally designated 110 (best seen in Figs 6A and 6B), connected to the printing control. Magnetic sensor 110 indicates to the printer when the cartridge 20 100 requires to be changed.

Reference is now made to Figs. 6A and 6B, which illustrate the operation of the magnetic sensor 110. Magnetic sensor 110 can be any suitable

sensor known in the art, such as the reed-relay type sensor and generally comprises a magnet 112 coupled to a reed switch 114.

Fig. 6A illustrates the ink bag 14 in a filled state. In this case, the metal element 102 is far from magnetic sensor 110, which is closed indicating an "on" 5 state.

As the bag 14 empties of ink, the metal element 102 descends until it reaches its lowest position resting on an almost empty bag 14 (Fig. 6B). In this position, metal element 102 lies proximate to magnetic sensor 110. Magnetic sensor 110 registers the presence of metal element 102 and de-activates the 10 switch 114 indicating an "off" or "empty" signal.

Metal element 102 comprises an annulus 116 formed in the middle thereof. Consequently, as is best seen in Fig. 7, to which reference is now also made, the sharp point 24 of needle 22 again punctures the ink bag 14, thereby rendering the bag 14 unusable.

15 Reference is now made to Fig. 8 which illustrates a further embodiment of an ink cartridge, generally designated 200, according to a preferred embodiment of the present invention.

Elements of this embodiment of the invention which are similar to elements which have been previously described with respect to the preferred 20 embodiment hereinabove, are similarly designated and will not be further described.

Ink cartridge 200 which may be similar either ink cartridge 10 or 100, described hereinabove, further comprises an exterior indicating element 202

attached to the housing 12 of cartridge 200. Indicating element 202 may be a sticker or painted symbol showing the trade mark of the supplier, and is preferably composed of a conductive paint or similar material on a white painted background.

5        The printing mechanism comprises a detector 203 which can detect the geometric form of element 202 and match it in CPU 208 to the original dimensions and form of the supplier's logo or trademark. Detector 203 can operate on basis of known methods of conductivity detection or by non-contact optical scanning, operating similar to hand held text readers.

10       The printer can be configured to sound an alarm and shut down, for example, if a forged or missing indicator 202 is detected. Thus, only a genuine cartridge, properly marked, would be usable with a specific printer.

15       Alternatively, a relief of the logo or trademark is formed on the cartridge with the corresponding negative of the logo or trademark formed on housing of the printer. Both parts of the logo (relief and its negative) must match to enable the cartridge to be properly connected to the printer.

It will be appreciated by persons knowledgeable in the art that the use of a conductive indicating element detectable by a detector means or a relief indicator are given by way of example only and is not restricted thereto.

20       Preferably, ink cartridge 200 further comprises a processing unit 210, preferably having read/write memory such as an EEPROM unit for storing identification data related to the cartridge 200. The cartridge 200 can be coupled by means of a suitable connector 212 to the CPU and control unit 208 inside the

printer. The encryption data stored in processing unit 210 can be used to detect whether the cartridge unit being installed is genuine. Preferably, processing unit 210 is suitably installed in the cartridge so that any attempt to remove it will destroy it.

5 Reference is now also made to Fig. 9 which is a flow chart illustration of the method for detecting a genuine manufacturer supplied ink cartridge and preventing the use of a non-genuine cartridge.

10 The cartridge unit 200 is installed and coupled to the CPU 208 in the printer (step 302). CPU 208 sends a randomly generated number ("code") to the cartridge processing unit 210 (step 304). The "code" is used by the processing unit 210 for encryption (step 306). Concurrently, the CPU 208 also performs the encryption algorithm utilizing the same "code" (step 308).

15 A comparison between the two encrypted results is made (query box 310). If the resulting encryptions are not identical, the printer indicates an error (step 312). The printer will only operate if the calculations are identical (step 314).

It will be appreciated that the present invention is not limited by what has been described hereinabove and that numerous modifications, all of which fall within the scope of the present invention, exist. For example, while the present invention has been described with respect to a replaceable ink cartridge for use in 20 a ink-jet printer, the invention is also applicable for use with other consumable items.

It will be appreciated by persons skilled in the art that the present invention is not limited by what has been particularly shown and described herein above. Rather the scope of the invention is defined by the claims which follow:

## CLAIMS

1. An ink cartridge comprising:
  - a. a rigid housing; and
  - b. a flexible ink storage bag inserted within said housing, said storage bag being connectable to the ink supply line of a printer by means of a hollow needle,  
5 wherein said storage bag is impenetrable by a needle when said storage bag is depleted of ink.
2. An ink cartridge according to claim 1 wherein said housing comprises  
10 upper and lower chambers connectable together.
3. An ink cartridge according to any of claims 1 and 2 wherein said housing further comprises an outlet port for connecting said housing to said printer.
4. An ink cartridge according to any of the previous claims and wherein said  
15 hollow needle comprises an angled sealed point formed in one end thereof.
5. An ink cartridge according to any of the previous claims and further comprising a metal element placed on top of said ink storage bag, said metal element descending as said ink storage bag is emptied.
- 20 6. An ink cartridge according to claim 5 wherein said metal element comprises an annulus formed therein.

7. An ink cartridge according to any of claims 5 - 6 wherein said metal element is composed of a ferrous material.
8. An ink cartridge according to claim 7 wherein said printer comprises a magnetic sensor proximate to the bottom of said lower chamber for sensing the presence of said ferrous metal element thereby to indicate the depletion of said storage bag.  
5
9. An ink cartridge according to any of the previous claims and further comprising an indicator representing a logo attached to the exterior face of said housing.
10. An ink cartridge according to claim 9 wherein said indicator is composed of conductive material responsive to electro-magnetic fields.  
10
11. An ink cartridge according to claim 10 wherein said printer comprises a detector for detecting the form of said indicator.  
15
12. An ink cartridge according to claim 9 wherein said indicator is a relief with a negative built into the housing of the printer.  
15
13. An ink cartridge according to any of the previous claims and further comprising a processing unit which may be coupled to the central processing unit of said printer.  
20
14. A method for verifying the authenticity of an ink cartridge having a processing unit coupled thereto, said method comprising the steps of:

- a. installing and connecting said ink cartridge to a printer having a central processing and control unit (CPU) connected thereto;
- b. said CPU sending a randomly generated number ("code") to said installed ink cartridge;
- 5 c. said CPU performing a first encryption algorithm on said code;
- d. said cartridge processing unit performing a second encryption algorithm on said code;
- e. comparing the resulting first and second encryption algorithms; and
- f. indicating an error if the resulting first and second encryption

10 algorithms are not identical.

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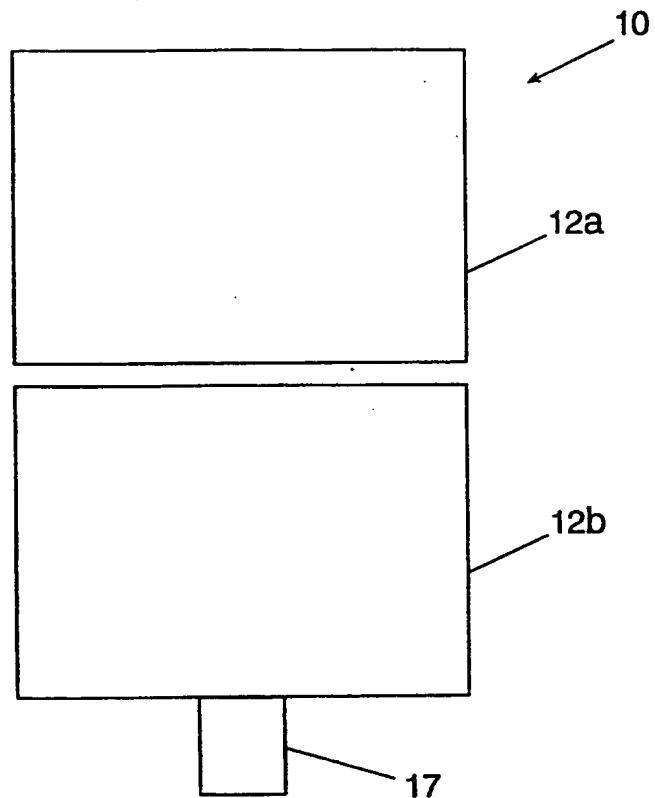


FIG. 1

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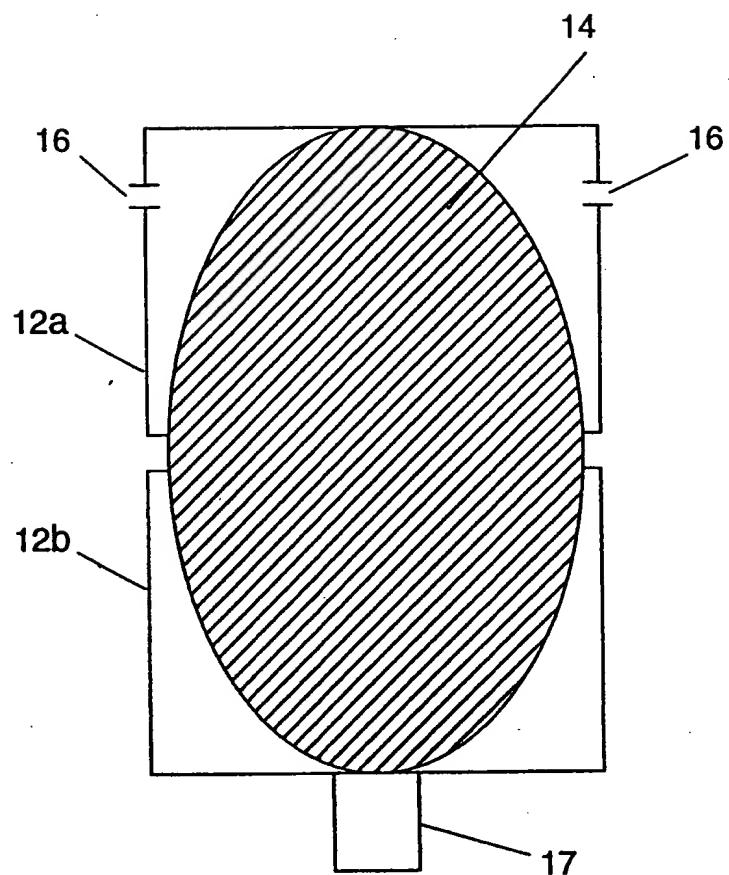


FIG. 2A

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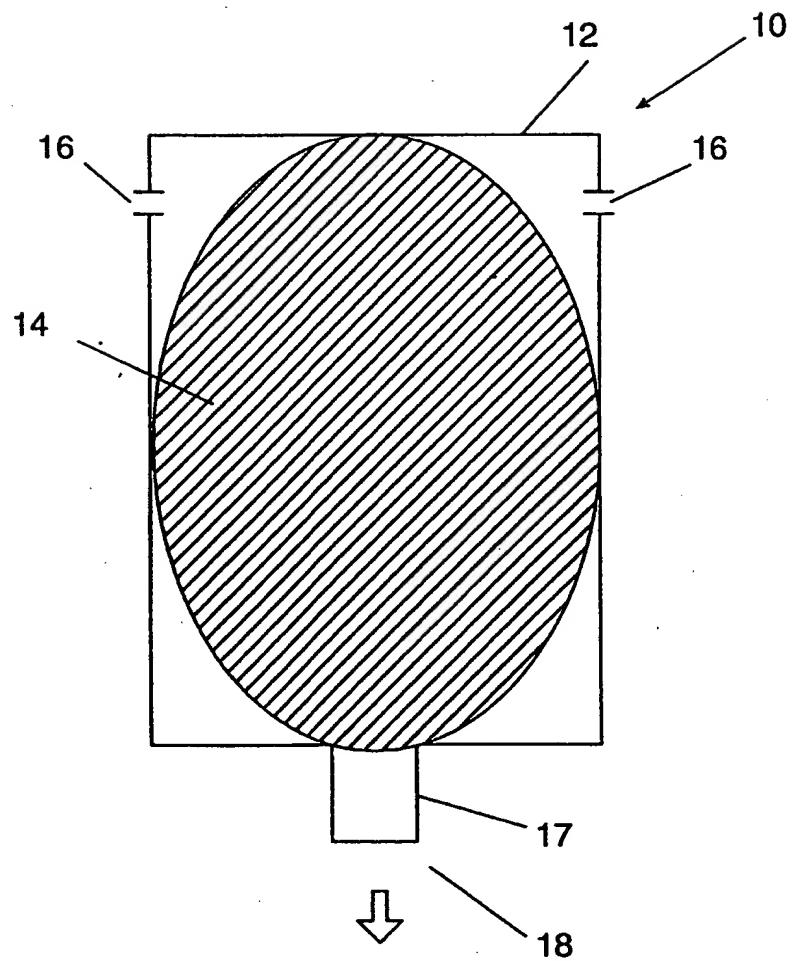


FIG. 2B

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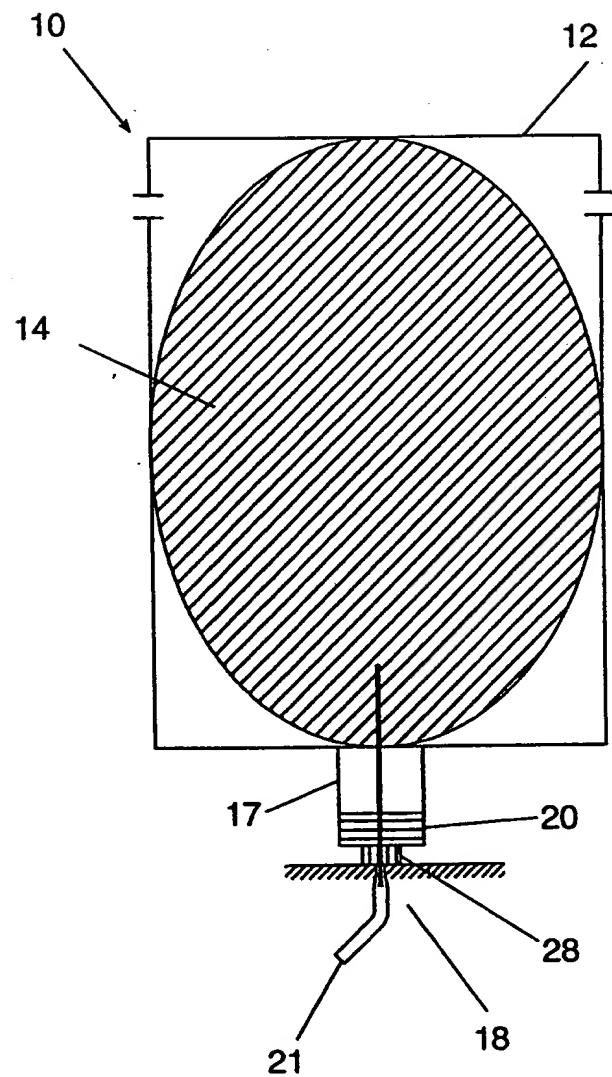


FIG. 3A

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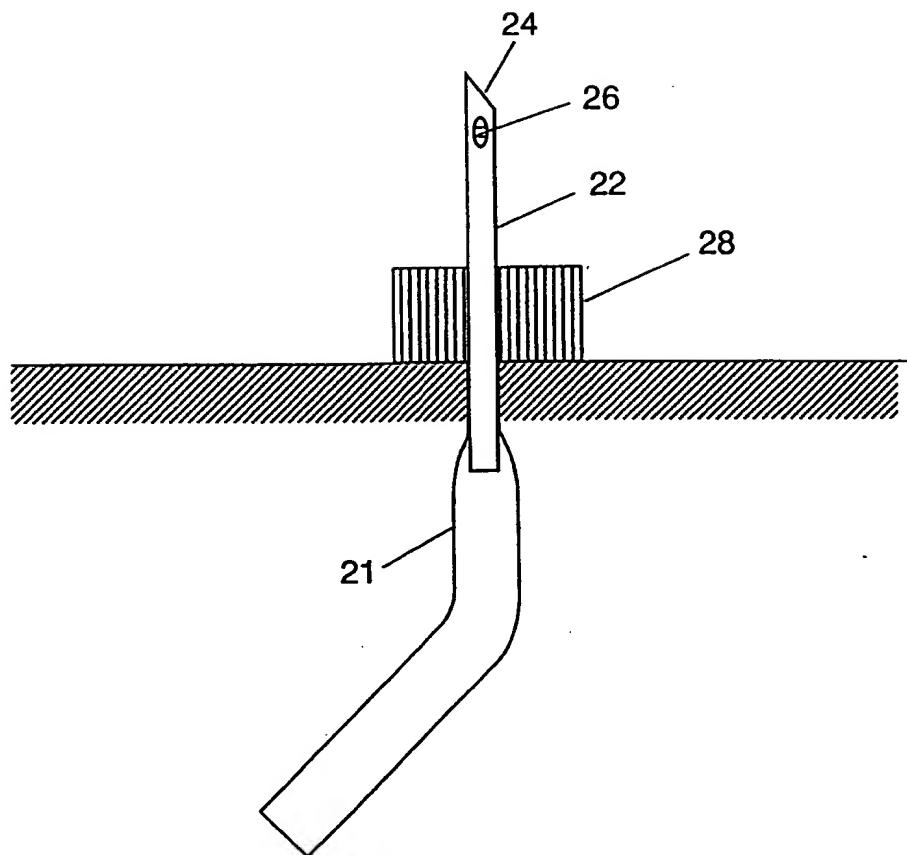


FIG. 3B

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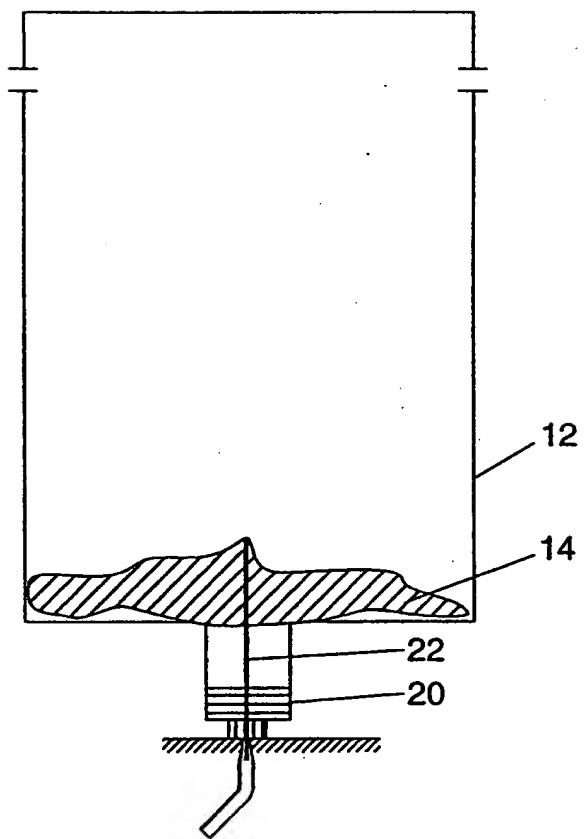


FIG. 4

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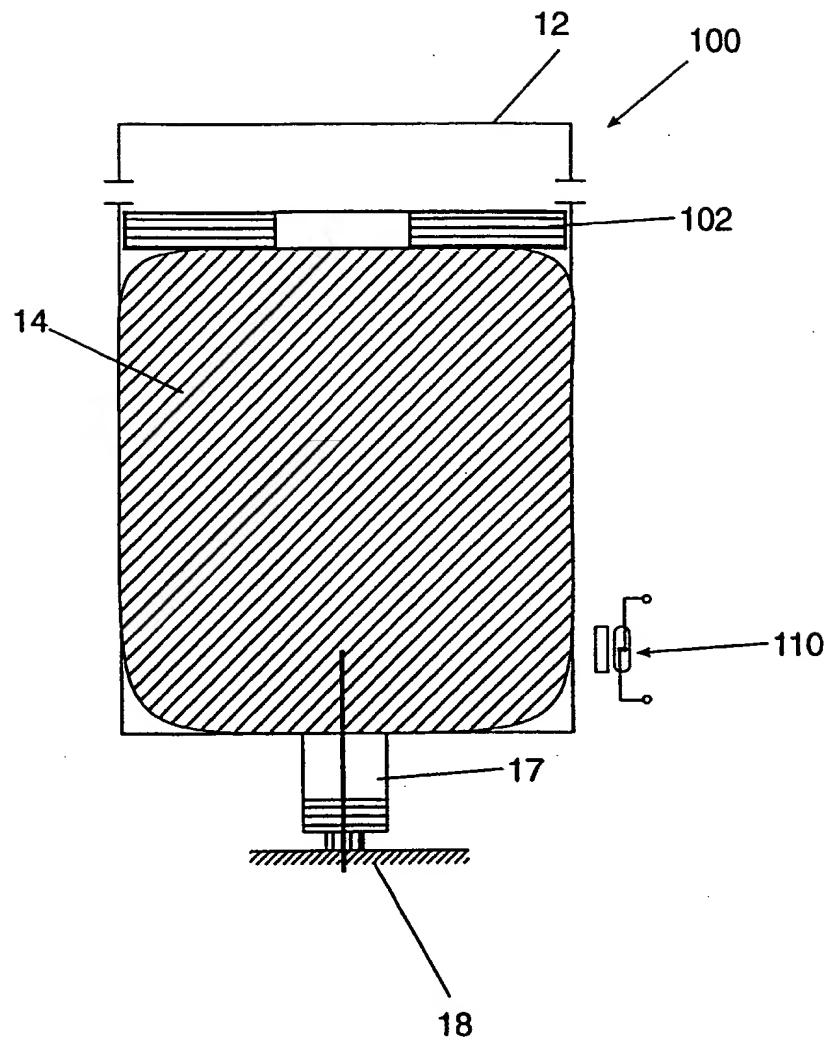


FIG. 5

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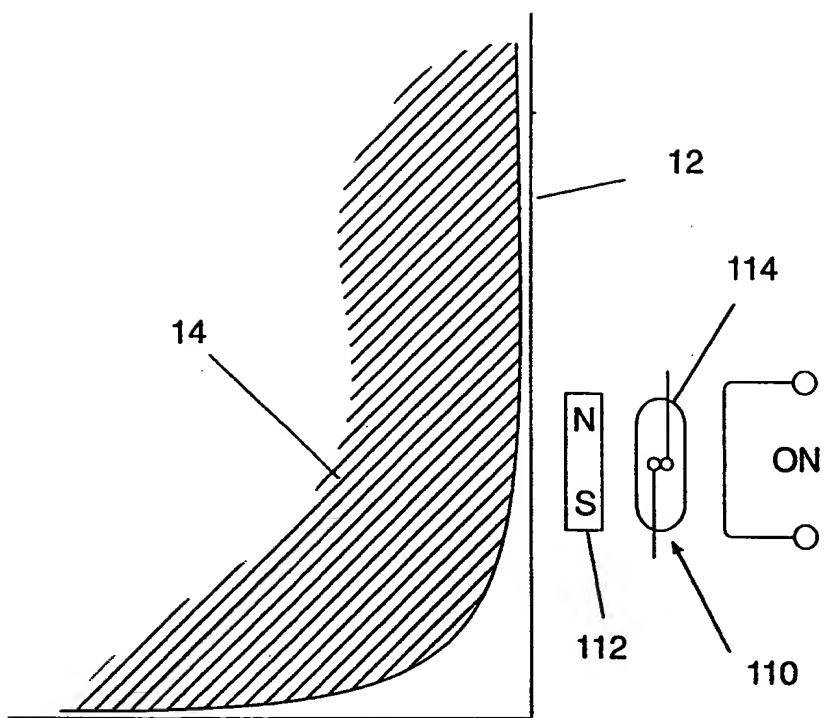


FIG. 6A

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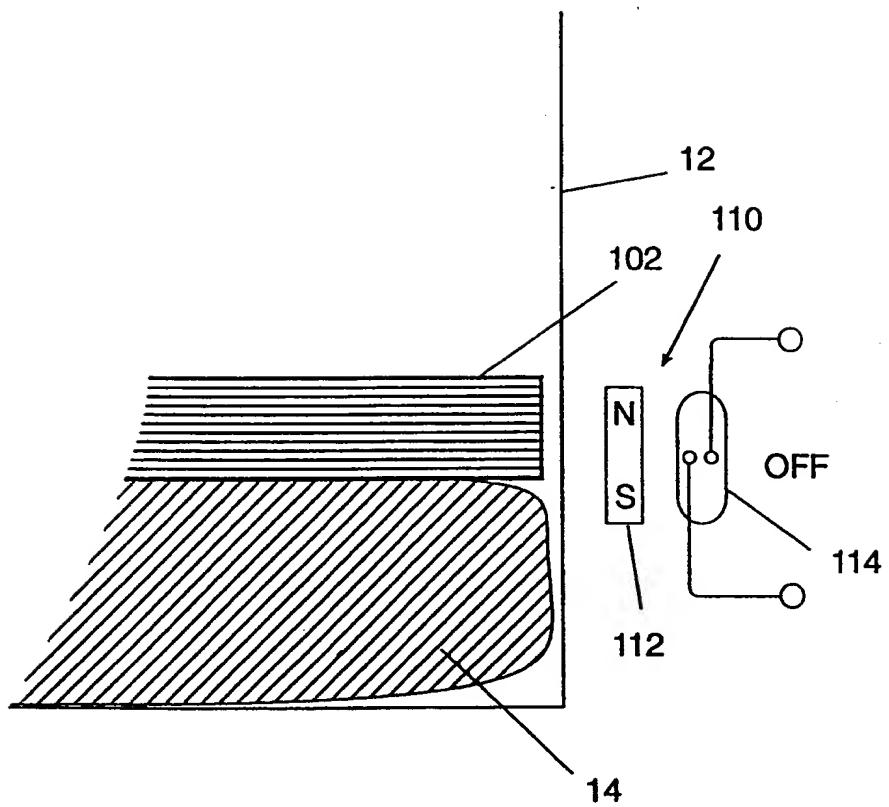


FIG. 6B

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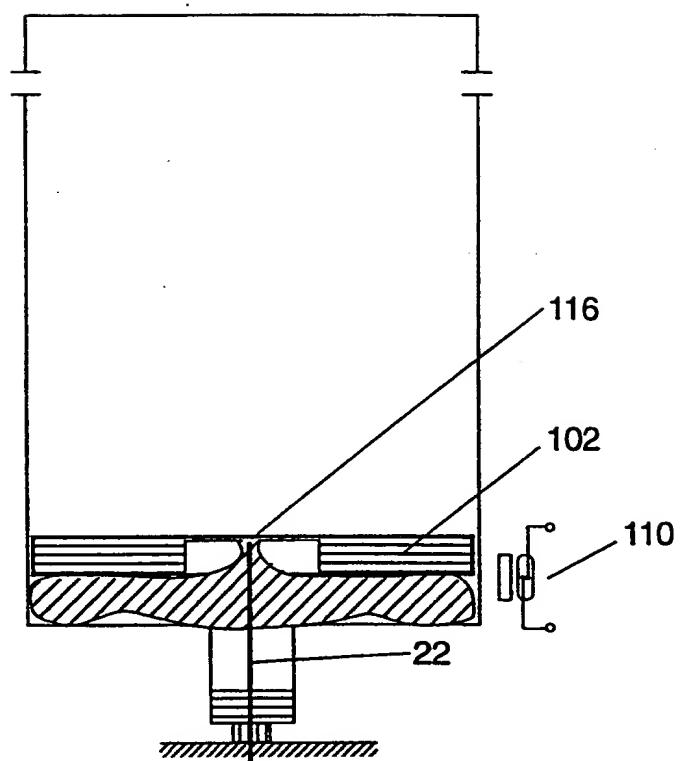


FIG. 7

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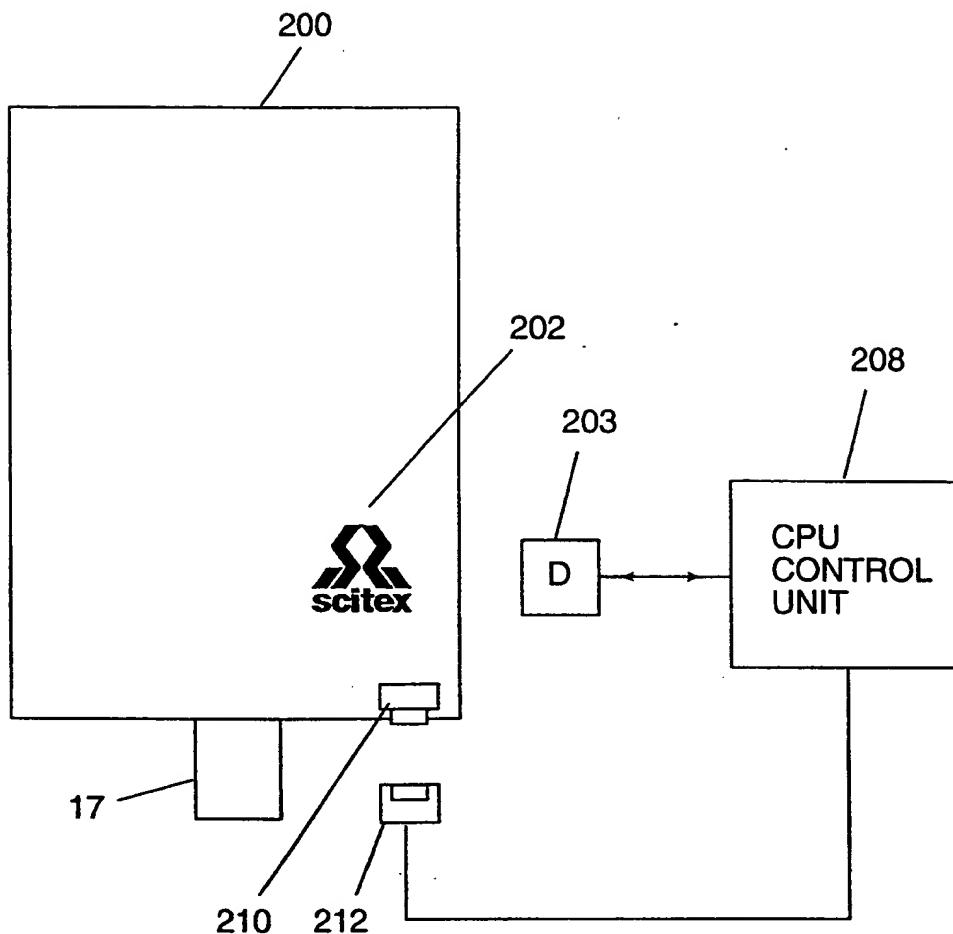


FIG. 8

12/12

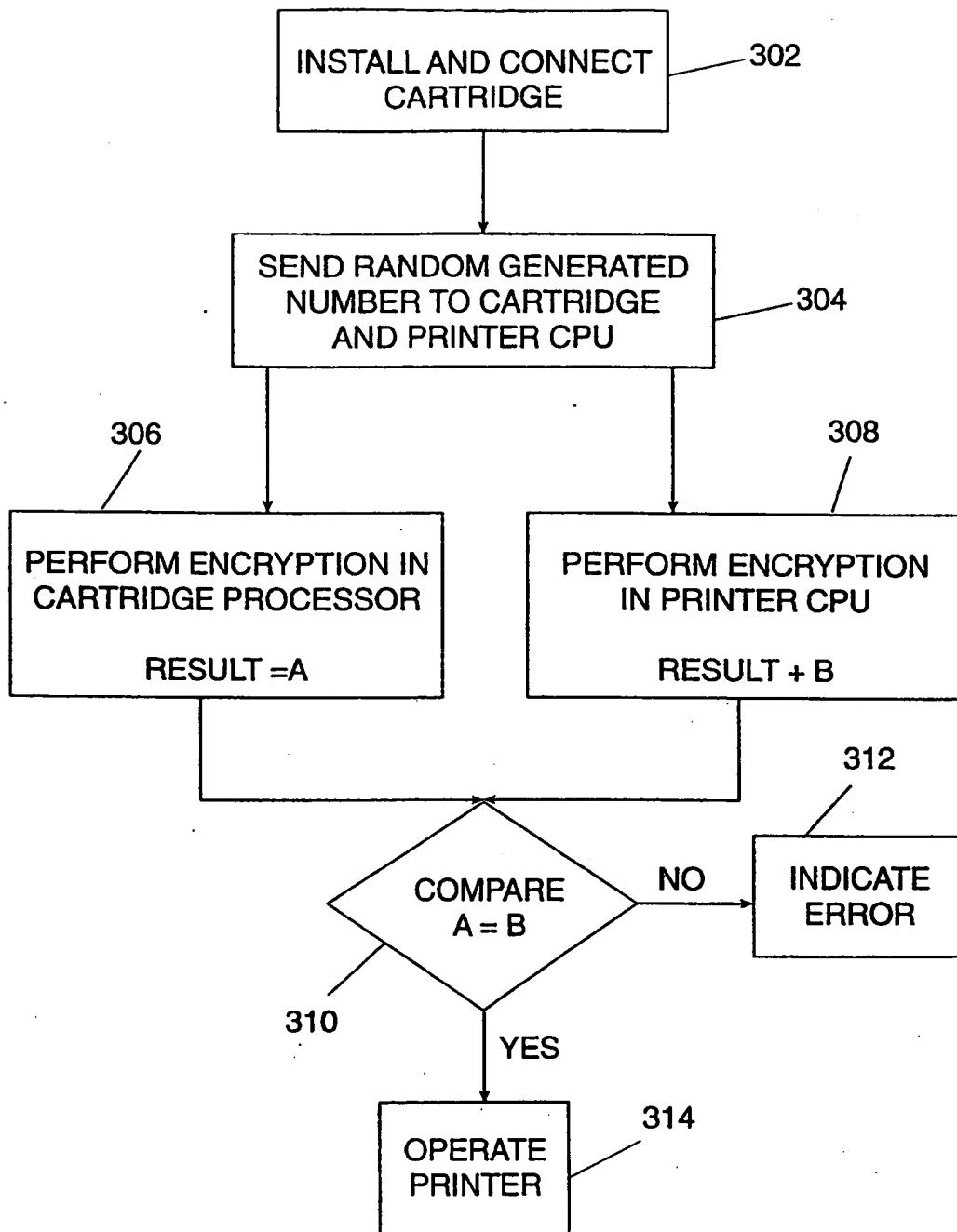


FIG. 9

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/IL98/00399

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : B41J 2/195

US CL : 347/7

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 347/7, 347/85, 347/86, 347/87, 347/19

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

IS&amp;R, APS

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

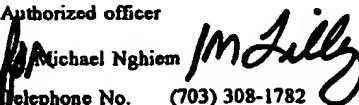
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,157,421 (KITAHARA 20 October 1992 (20.10.92), Fig. 2, elements 1, 1a, 7, 10, 20.	1-3
Y	US 5,138,344 (UJITA) 11 August 1992 (11.08.92), Figs. 6, 7, elements 50, 51, 32, s8, column 8, lines 14-16.	14

Further documents are listed in the continuation of Box C.

See patent family annex.

• Special categories of cited documents:	
•A• document defining the general state of the art which is not considered to be of particular relevance	•T• later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
•B• earlier document published on or after the international filing date	•X• document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
•L• document which may throw doubt on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	•Y• document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
•O• document referring to an oral disclosure, use, exhibition or other means	•Z• document member of the same patent family
•P• document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search	Date of mailing of the international search report
24 NOVEMBER 1998	30 DEC 1998

Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer  Michael Nghiem Telephone No. (703) 308-1782
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**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/IL98/00399

**Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.: because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3.  Claims Nos.: 4-13 because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**  

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.